Icy-Moon Cryo Environment Penetrating Ice Claw (ICE-PIC)

Completed Technology Project (2016 - 2019)

Project Introduction

The desire to explore the surfaces of icy moons, such as Europa, will require the development of a new generation of planetary mobility technologies. Wheeled and tracked vehicles are not suitable for the icy and steep slopes that may be encountered, while hopping approaches are inherently risky when adequate terrain assessment is not possible. Legged vehicles provide a promising avenue for traversing complex terrains, however icy surfaces will require anchoring mechanisms to maintain a secure hold. This is especially true for traversing steep slopes or cliff faces that may be encountered. The proposed effort is to develop a novel claw end effector to capitalize on the unique characteristics of an icy moon with effectively no atmosphere. With an electrical heating element embedded into a claw tip, the claw would safely sublimate a hole into the ice, resulting in a relatively undamaged hold point to provide traction, even up a sheer cliff face. The objectives of the proposed effort are to characterize the power, mass and performance of such an end effector, as applied to water ice at cryogenic temperatures under vacuum, and to demonstrate the implementation of these end effectors by integrating them into a simple legged mobile platform to conduct a variety of climbing maneuvers using a dry ice terrain analog at atmospheric pressure.

Anticipated Benefits

The desire to explore the surfaces of icy moons, such as Europa, will require the development of a new generation of planetary mobility technologies. Wheeled and tracked vehicles are not suitable for the icy and steep slopes that may be encountered, while hopping approaches are inherently risky when adequate terrain assessment is not possible. Legged vehicles provide a promising avenue for traversing complex terrains, however icy surfaces will require anchoring mechanisms to maintain a secure hold. This is especially true for traversing steep slopes or cliff faces that may be encountered. The proposed effort is to develop a novel claw end effector to capitalize on the unique characteristics of an icy moon with effectively no atmosphere. With an electrical heating element embedded into a claw tip, the claw would safely sublimate a hole into the ice, resulting in a relatively undamaged hold point to provide traction, even up a sheer cliff face. The objectives of the proposed effort are to characterize the power, mass and performance of such an end effector, as applied to water ice at cryogenic temperatures under vacuum, and to demonstrate the implementation of these end effectors by integrating them into a simple legged mobile platform to conduct a variety of climbing maneuvers using a dry ice terrain analog at atmospheric pressure.

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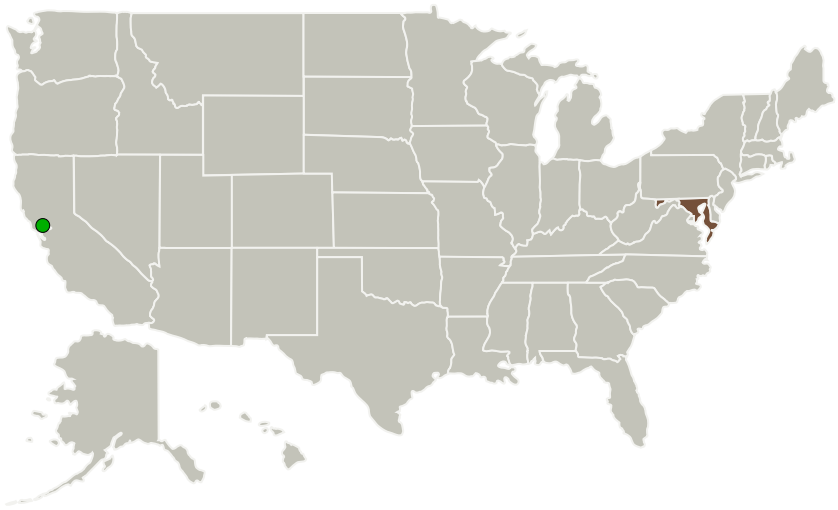
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Maryland-College Park(UMCP)	Lead Organization	Academia Asian American Native American Pacific Islander (AANAPISI)	College Park, Maryland
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations
Maryland

Project Website:

https://www.nasa.gov/strg#.VQb6T0jJzyE

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Maryland-College Park (UMCP)

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

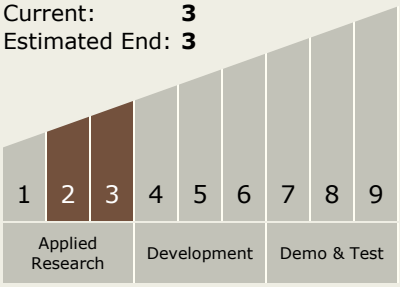
Hung D Nguyen

Principal Investigator:

Raymond Sedwick

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.2 Mobility
    - TX04.2.4 Surface Mobility

Target Destination

The Sun